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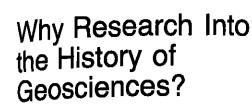
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Wilfried Schröder

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### introduction

Study of the history of various sciences is rather heterogeneous. Some disciplines, such as medicine, mathematks, and astronomy, have numerous noteworthy compendia and even specialized journals where papers on the history of these sciences can be published.

The situation in geophysics, meteorology, and other subdivisions of the geosciences is far less favorable. This neglect is an outcome of a dogma of autonomy that is essenially oriented toward progress in understanding, without much reference to historical developments. But even the geoscientists cannot ignore that the phenomenon 'science' must be viewed in the context of sociological processes. In the initial stages, sociologists and some philosophers, in the context of the general theory of perception, began research into the development of scientific thought, but the cientists and other natural scientists contributed very ittle. It has since become clear that research on these topics requires historical assessment and more insight. The development of the 'science of science' is directed toward understanding and explanation of the complex human involvement in science, not only in the sense of theorizing about the scientific processes but also in sociological, political, and historical context [Kuhn, 1973; Burrichter, 1979; Sandkühler and Plath, 1979]

Such studies require profound knowledge of many disciplines. The history of science can contribute to a better understanding of these individual disciplines and their interaction toward a better understanding of the overall phenome-

### Opportunities for Historical Research in **Geosciences**

A number of investigations in recent years have made it dear that for better insight, meteorology and geophysics cannot neglect historical reviews. The problem is that geoscientists, as a rule, are not acquainted with the methods of history and philosophy. This raises the question of how historical studies in these fields can be promoted. I believe the American Geophysical Union and the International Union of Geodesy and Geophysics can be of notable assistance.

It is rather evident that historical questions have not found a place in AGU meetings. The AGU journals, Eos ex-



Tobias Mayer (1752-1830), professor of physics at the University of Gottingen.

cepted, have no space for contributions of historical material in the particular sciences. Why is this so? There seems to be no lack of interest because there were several atlempts to activate some historical research in the AGU framework. Two measures would be helpful to promote such work:

(a) Have invited lectures on these topics at AGU meet-

(b) Offer publication opportunities in AGU journals. The dilemma is rather clear: A geophysicist or meteorologist who wishes to present historical research does not know where and how. The meetings are reserved for presentations of current research results. There is hardly time for history of science, something that ought to be remedied to offer some opportunities for pertinent papers. But far more difficult is the problem of publication. Where should such papers be published? The traditional journals for the history of science, such as Isis, Centaurus. Journal for History of Astronomy, Sudhoff's Archiv, NTM-Zeilschrift für Geschichte der Naturwissenschaften, are not read by geoscientists and certainly not subscribed to by the geophysical-meteorological institutions. This raises the question of what is a sultable journal, i.e., is it responsive to needs of the geosciences? While astronomy has such a specialized Journal, there is no counterpart in the geosciences.

There are a number of potential topics for geoscience history. Let me cite several. It is clear that historical weather observations are of importance to modern climatological research (International Conference on Climate and History, 1979; Landsberg. 1980aj. This involves not only extensive literature study but also archival work, including manuscripts and letters. It seems to me equally important to learn about the instruments used for the appropriate reconstruction of the data and also information about the observers who collected the data. This should include biographical studies via the use of original literature and correspondence. The climatological studies need broadening into the field of hydrology. In that field, considerable ancillary work has been done by publication of a source collection by Welkinn [1958-64]. Thanks to the support of the wellknown geophysicist and meteorologist Hans Ertel (1904-1971). Welkinn was able to sludy a large number of original sources, covering many centuries that reveal much about climate and hydrology. These were published in four substantial volumes, 1958-1964.

The auroras offer another example of how modern re-search and historical science studies converge. Many current studies of auroras refer often to Hermann Fritz (1830-1893), who published the well-known 'Verzeichnis beobachte Polarlichter' (Catalogue of Observed Polar Lights; Vienna, 1873). For Scandinavia, Sophus Tromhöll (1851-1896) also presented a large catalogue of auroras (Catalog der in Norwegen bis Juli 1878 beobachteten Nordlichter, Jacob Dybwald Publ. Co., Christiana, Norway, 1902). II seems quite clear that the discussions about the so-called Maunder Minimum [Glelesberg, 1977; Schröder, 1979; Landsberg, 1980b) require further reconstruction of old auroral data. In scrutinizing old weather diaries, Landsberg [1980] found additional auroral observations not catalogued by Fritz [1873]. Moreover, these studies show the change of science concepts thrugh time. In the beginning of the modern period (16-17th century), auroras were regarded as myths, miracles, or inexplicable metaphysical events which were beyond physical explanations by earthbound humans. It is rather intriguing to reflect on the interpretations of these reactions by the psychologist Carl Gustav Jung (1875-1961), who conjectured that the existential threats and anxieties of individuals on earth were projected into the sky. This is also reflected in the early pictorial presentations where, around the core of a natural phenomenon, these anxieties were anistically illustrated. Hence the ancient pictures of sky manifestations always show scenes of death, warfare, storm, and distress. Such aspects have relevance to the development of the geosciences in a historical framework [see, e.g., Jung, 1958; Amstutz, 1976].

The march of thought in the gradual development of geo-

sciences is also worthy of historical investigation. The appearance of hypotheses, the acceptance of theories and their testing, as well as the gradual changes in concepts can often be understood only in connection with knowledge of the originating research personalities. The progress in theoretical meteorology recalls the sequence of creative

leaders such as V. Bjerknes (1862-1951), L. F. Richardson (1881-1953), C. G. Rossby (1898-1957), and H. Ertel (1904-1971) Noteworthy also has been the development of hypotheses about the constitution of the interior of the earth. This

plitted physicists against geologists in the 19th century and geophysicists against cosmologists in the 20th. The large perlinent literature has been reviewed in several essays by Brush [1977, 1980].

### What measures are necessary?

The understanding of the growth processes of natural sciences requires historical reflections. In addition to the disciplinary research it is essential to promote studies that elucidate the context of discovery in the sciences. This will involve topics which, by use of critical historical methods, will explore the higher-order circumstances leading to growth in geophysics and meteorology. In this context, let me pose a simple problem: What led to the establishment of geophysics (and meteorology) as a separate discipline? Ertel [1953a] had pointed out that the subdivisions of geophysics that existed in the 18th century did not develop in a straightforward way. Shortly after the death of G. W. von Leibniz (1646-1716), as Ertel noted, the problem of a precise determination of the figure of the earth prompted rapid



Sophus Tromhók (1851-1896), a Norwegian scientist, published a comprehensive auroral catalog for Scandinevia

advances in geodesy, astronomy, and cosmogony. According to Ertel, a new phase in the development of geophysics started with Alexander von Humboldt, when meteorology, climatology, hydrology, geomagnetism, and seismology separated from the framework of geography and became separate subdisciplines. In modern times the economic aspects led to rapid developments in applied geophysics, and the interaction of practical requirements with pure research are of interest in the growth of the geosciences (Ertel.

Many generations of researchers of all nations have parlicipated in the various phases of development of meleorolony and geophysics. Yet it was not only individual scientists who advanced the science, as in other disciplines [Kuhn, 1973; Zilsel, 1976; Sandkühler and Plath, 1979], but also the great international programs, including the international polar years, the International Geophysical Year, the Global Atmospheric Research Program, etc. Also important were sponsoring institutions, including academies of sciences, which had, for example, a decisive influence on the devel-

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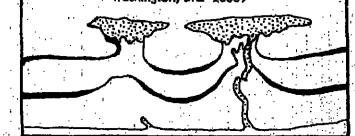
# THE EARTH'S CRUST

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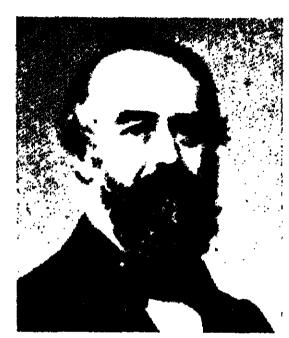
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Hormann Fritz (1830–1893), founder of modern auroral re-



Rudolf Wolf (1816–1893), Swiss astronomer and ptoneer of solar physics.

opment of climatology (Landsberg, 1964). These institutions also supported the observations of the consequences of the Krakatoa eruption (these observations being inaugurated by the Royal Society in 1883–84), the Norwegian Aurora Program, and others.

It must astonish geophysicists that the origin of geophys-

ics as an independent discipline and even the source of the word 'geophysics' is not fully clarified [Kertz, 1979]. Many of the highly controversial problems of environmental research are geophysical in nature and require assessment of observations taken in the past, much of which need historical studies to ascertain validity.

## Bases and Sources for History of Geophysics and Meteorology

Besides the knowledge in printed works, it is also indispensible to obtain archived documentation as well as information on instruments used in geophysical work. There is a need for production of bibliographies of the older literature, as is presently done through the 'Meteorological and Geoastrophysical Abstracts.'

Particularly Important is the accession and preservation of correspondence. In recent years I have carried on some pertinent studies and had to find that for many important scientists no documents are at all available. This is an immense loss for research. Equally important is the collection of the transactions of committees and the administrative files pertaining to establishment of projects and institutions. Also essential are undisclosed materials for personal histories, autobiographies, and pictures that may throw light not only on scientific but also sociological aspects of science history. Finally a comment about historical instruments: They need to be rehabilitated and recalibrated to ascertain their accuracy. It may help in the reconstruction of long observational time series, which remain of contemporary interest [Weber, 1972].

This essay has been written not only to acquaint a large circle of geophysicists with the necessity of historical aspects in geophysics but also to silmulate interested colleagues to contribute to the history of the geosciences through their own writings. The group on history established in the international Association for Aeronomy and Geomagnetism (IAGA) deserves the ardent support of researchers in the field, and establishment of similar commissions or subcommissions in the other associations of IUGG is to be much desired. It is hoped that many geoscientists will use their influence to foster the historical aspects of their respective fields.

### Acknowledgment

I am indebted to H. E. Landsberg for translation help, useful hints on fiterature, and for stimulating my interests in the history of science. I am grateful to libraries in Zürich, Frankfurt, Oslo, and Göttingen.

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Wilfried Schröder is a member of the IAGA History Commission His main interest is in the physics of the upper atmosphere (including noctilucent clouds), solar-terrestrial physics, and the history of geophysics and meteorology of the 14th—19th century, which has led him into many detailed studies of noctilucent clouds, mesospheric circulation, and long-term observation of auroras in middle latitudes. In 1975 he published a book on noctilucent clouds, entitled Entwicklungsphasen der Erforschung der Leuchtenden Nachtwolken. His new book, Disziplingeschichte als Wissenschaftliche Seibstrellexion der Historischen Wissenschaftsforschung, deals with the history and philosophy of geosciences and will be published later this year. He is currently engaged in an edition of the scientific correspondence of Emil Wiechert and in wilting a book on the development of history of auroral research. He is interested in all phases of the history of geosciences and the philosophy of science.

# News

# Improved Weather Satellite

The second of three improved geostationary operational environmental satellites (GOES) was launched May 14 for the National Oceanic and Atmospheric Administration (NOAA). The National Aeronautics and Space Administration (NASA) launched the satellite from the Kennedy Space Center, placing it in orbit at an altitude of 36,000 km (see figure).

Ultimately, the spacecraft will replace an older and similar satellite that monitors the eastern half of the United States and Canada, all of Central and South America, and much of the Atlantic Ocean. The new satellite will watch hurricane development and movement in the Caribbean and provide data on the Gulf Stream and crop killing frost for mariners and Florida citrus growers, respectively.

Government and private weathercasters will depend upon data from the satellite, also called GOES East, for weather forecasting and a number of other uses.

A twin satellite, GOES West, provides similar data on the western portion of the United States and Canada and much of the eastern Pacific Ocean. It is positioned above the equator.

The third geostationary satellite is scheduled for launch during early 1982.

# GOES-E Mission

GOES-E is the seventh spacecraft in the SMS/GOES series placed into Earth-synchronous orbit to provide near continual, high-resolution, visual and infrared imaging over large areas of North and South America and surrounding oceans at least every 30 minutes; to collect environmental data from up to 10,000 remote observing platforms on land, in the ocean, and in the air; to measure energetic solar particle flux, X rays, and the strength of the earth's magnetic fleid; and, to broadcast centrally prepared weather and satellite information.

GOES-E, like its predecessor GOES 4, contains an experimental, advanced type of meteorological sensor that not only observes the traditional visible light and infrared images of cloud formations and motion but also, on command, temperature variations with light in the atmosphere, and it will map the distribution of water vapor in the air. This instrument is called the visible infrared spin-scan radiometric atmospheric sounder (VAS) and was shown to have significant meteorological use as a geosynchronous temperature sounder during its initial experimental runs with GOES 4 between October 1980 and January 1981

Two GOES satellites presently are operational: one at 135°W, observing North America and the Pacific Ocean to west of Hawaii, and a second at 75°W, observing both North and South America and the Atlantic Ocean. They are at attitudes of approximately 35,800 km and are in circular orbit traveling at about 11,000 km/h.

# Instrumentation

The spacecraft on-board subsystems include VAS; the space environmental monitor (SEM), which includes a magnetometer, a solar X ray telescope, and an energetic particle monitor, designed to provide direct quantitative measurements of the important effects of solar activity for use in real time solar forecasting and subsequent research; the data collection system (DCS), which provides communicalions relay from data collection platforms on land, at sea, and in the air to the command and data acquisition station (CDA) and the interrogation of platforms from the CDA via the satellite; the telemetry, tracking and command (TTC) subsystem, which uses S band frequencies for transmission of wideband video data to the CDA, for relay of "aireiched" data from the CDA vie the spacecraft to facilities operated by NOAA's National Earth Satellite Service in Sulland, Md., and for transmission of weather faceimile data to local ground stations equipped to receive S band automatic picture transmission (APT) data.

# SATELLITE S SAND HIGH GAIN ANTENNA UHF ANTENNA THERMAL BARRIER WAS SECTION X-RAY SEASGR SOLAR PANEL EPS TELESCOPE S B BAND BICUNE OMNI ANTENNA THERMAL BARRIER AXIAL THRUST SENSOR SUN SENSORS EPS TELESCOPE

Data Acquisition and Distribution

Unprocessed VAS data is transmitted via the S-band system to the 18,3-m dish antenna at the Wallops Island, VA, CDA, The CDA processes the incoming data in a system to 1 tor simplification of data transmission. The CDA protection is the simplification of data transmission.

casses and retransmits this 'stretched' data back to the satellite. The lower resolution infrared data are formatted in special computers for analog transmission via 3-kHz telephone lines directly to the satellite field services stations and to the central data distribution facility.

Satellite field services stations are at Camp Springs, Md.; Miami, Fia.; Kansas City, Mo.; San Francisco, Calif.; Honolulu, Hawaii; and Anchorage, Alaska. They receive a standard 'menu' of Imagery on a half hour or more frequent basis, day and night, for analysis and retransmission to National Weather Service offices and other uses via dedicated telephone lines. [Sources: NASA, NOAA]—PMB 33

### McGetchin Award Funds Students

The McGetchin Volcano Fund will support volcanology field work for three students this summer. Established last year, the fund honors the late Thomas McGetchin, former director of the Lunar and Planetary Institute in Houston. This summer, Mark S. Wigmosta, a senior at the University of Washington, will research the dynamics of the Toutle

sity of Washington, will research the dynamics of the Toutle River mudflows triggered by the eruption of Mount St. Helens on May 18, 1980. Tanya Furman, a Junior at Princeton University, will examine a Sierra Nevada zoned granodioritic pluton that displays a tonalitic rim. Douglas Coephy, a Comell University senior, will study field stratigraphy and

nature of postglacial ash deposits of Adak Island in Alaska Allernates, also chosen by the fund's executive committee are John Spurney (Kent State University). Tom Brikowski (University of Oregon), and William F. McDonough (Sul Ross State University).

Inquiries about the fund should be addressed to McGetchin Volcano Fund, Lunar and Planetary Institute, 3303 NASA Road 1, Houston, TX 77058. SS

### Acid Rain Measurements

The United States and Canada have launched a project to determine whether the methods they use to measure acid rain produce compatible results. Apparently, the U.S. and Canadian findings may not be comparable because of differences in the way they collect and analyze data.

The U.S. separately collects precipitation from snow and rain as well as dry, windblown material. The samples are gathered and analyzed weekly. The Canadians use instruments that collect only water. They gather and test their samples monthly.

The instruments being used by the two countries have

been placed at three sites in both the U.S. and Canada. Investigators from each country are testing the samples collected for such major contributors to acidity as sulfates and nitrates. The analysis is expected to reveal any differences between the two methods of collecting and analyzing data.

Colorado State University is conducting and analyzing data.

Colorado State University is conducting the U.S. Instrument studies under a NOAA contract. A Canadian government agency, Environment Canada, is performing its study. The Illinois State Water Survey will analyze rain samples collected here.

Collectors have been placed at a National Weather Service site in Carlbou, Maine; an agricultural experiment station in Marcel, Minn.; and Glacier National Park, Montana. Environment Canada has provided sites at Leihbridge, Alberta; Mount Forest, Ontario; and Kejimkujik, Nova Scolia. [Source: U.S. Dept. Commerce]—PMB &

# Finalists Chosen in Shuttle Student Project

Ten finalists from 191 semifinal entries have been selected in the first national Space Shuttle Student involvement Project, a joint venture of NASA and the National Science Teachers Association. The objective of the project is to stimulate the study of science and technology in grades 9 through 12 by engaging students in a competition to devel-

op experiments suitable for flight aboard the Space Shuttle. Interdisciplinary teams of teachers, scientists, and engineers reviewed more than 1500 proposals; grouped them Into 10 geographic regions; and selected the semifinalists. Regional conferences for the semifinalists were held this spring at various NASA field centers.

Semifinalist proposals were then judged by a national team which selected the 10 finalists on the basis of individual scientific engineering merit for potential flight aboard the shuttle.

The 10 national winners and their teacher-advisors will attend a special space shuttle conference in August at Kennedy Space Center, Florida. The students will receive instructions and advice on how to prepare their experiments for payload assignment and review the procedures for integrating their experiments into a specific space shuttle mission. Finalists and teachers will tour the Kennedy Space Center facility and will view the shuttle Columbia, in preparation for its second flight in October.

To broaden participation in the program, NASA is encouraging U.S. industrial firms and other groups to sponsor student winners and assist them in transforming winning proposals into experiments. Industries or other organizations interested in serving as a sponsor should write to

Glen P. Wilson, Acting Director, Academic Affairs Division, NASA Headquarters, Mail Code LC-16, Washington, D.C. 20546

The sponsor should be prepared to assign a company scientist to work with the student as well as provide necessary funding for student travel, hardware development, and other costs related to pre- and postflight analysis and reporting. Student experiments will receive a thorough pre-flight review and safety analysis by NASA, in a procedure similar to the review and analysis given to operational payloads.

In some cases, where a sponsor cannot be found or where the student proposal closely parallels a professional experiment already planned for a space shuttle mission, NASA may arrange for the student to work with a principal investigator as part of an existing research team.

In other cases, minor modifications of professional experiment operations or the collection of special data from existing instruments may be made to accommodate the student proposals. In all cases, NASA will make every effort to see that the student receives sufficient information to write a final report.

Winning national Space Shuttle Student Involvement Project experiments will be assigned to specific shuttle flights as the experiments are ready, as space is available, and as future shuttle flights are confirmed.

Assisted by the sponsor and/or a NASA advisor, the student will analyze the data returned from the experiment and prepare a final report. All scientific data from the student experiments will be in the public domain and made available from the National Space Science Data Center at NASA's Goddard Space Flight Center, Groenbelt, Md.

A second Space Shuttle Student Involvement Project contest will open in September with regional conferences to be held in March 1982 and student winners selected in May 1982. NASA plans to increase the number of student winners for this competition from 10 to 20 finalists. [Source: NASA]—PMB ©:

### Geophysicists

Roy A. Balley has been appointed coordinator of the Volcano Hazards Program at the U.S. Geological Survey's National Center. He was project chief of the Long Valley Geothermal Mapping Project before the appointment.

Dagmar R. Cronn, assistant professor and research chemist at the Washington State University's chemical engineering department, received a Class II national fellowship from the W. K. Kellogg Foundation.

# **New Publications**

# Turbulence in the Free Atmosphere,

N.K. Vinnichenko, N. Z. Pinus, S. M. Shmeter, and G. N. Shur, Pienum, New York, xiii + 310 pp., 1980, \$49.50.

# Reviewed by Donald H. Lenschow

This second edition translation contains a wealth of information on observational investigations of atmospheric turbulence, particularly measurements from aircraft, mostly in the Soviet Union. The observations extend from a few meters above the surface to well into the stratosphere. Although a somewhat narrower focus is implied by the book file, boundary layer observations are discussed as well (although not within the context of surface or mixed layer scaling parameters).

The first three chapters set the stage for the rest of the ook. The first chapter discusses in rather cursory fashion a lew of the theoretical concepts for the observations disussed later. The discussion is not very rigorous and relies eavily on an eddy diffusivity ('K' theory) to relate momenium flux to the mean wind shear. In discussion of a critical ichardson number, for example, turbulence dissipation is Prored and the transports of heat, momentum and turbuance energy are all assumed to depend upon the same Value of K. The second chapter discusses measurement Billy involving aircraft. The discussion indudes estimating turbulent guess from vertical acceleration Measurements and aircraft response characteristics, airtome Doppler radar measurements of ground speed and diff angle, and measuring air velocity by use of hot-wire and sonic anemometers, vanes, and differential pressure Nobes. Remote sensing techniques (e.g., radars) are menloned only in passing, with little discussion of the tech-Niques and no examples of their capabilities. There is no discussion of the more modern alroraft systems that have been utilized in the West during the past decade which incorporate inertial navigation systems (INS) to measure airtrait position, velocity, and attitude angles. By combining these systems with air speed and flow angle sensors, air molions can be measured from an aircraft over essentially al frequencies of interest with an accuracy and resolution that can far exceed open-loop gyroscope-accelerometer and Doppler navigation systems. The third chapter disuses in considerable detail techniques and interpretation ol spectral analysis.

The rest of the book discusses theory and observations of specific types of turbulent motions and conclusions that can be drawn from them. Turbulence Intensity and spectra is stratified atmospheric layers, including the unstably strates somewhat disappointing; however, that in these and otherms of the variables that generate turbulence. Rather,

much of the discussion is qualitative, and quantitative results are mainly statistical rather than physical. For example, to specify the vertical distribution of turbulence, values of the averaged turbulence transfer coefficient are presented as a function of height. Values of this derived coefficient (which, as the authors note, can vary by 4 orders of magnitude) are obtained from aircraft flight performance parameters, acceleration data, and mean lifetime of the load increments. Nevertheless, an impressive list of observational results, mainly from the Soviet Union, is cited.

The next three chapters deal with turbulence and turbulent interactions associated with convection (both in clear air and cloud) and waves (gravity-shear and mountain, as well as rotors and turbulence in the lee of mountains). The background discussion that sets the stage for the observations that follow is clear and readable. It does not, however, summarize the current state of knowledge in these areas. Furthermore, there is no mention of numerical modeling or laboratory simulations of convection and mountain waves which, in recent years, have provided data for comparison with observations.

Chapter 9 differs from the rest of the book in that it deals with the effects of turbulence on aircraft. This includes a discussion of the scale of turbulence affecting aircraft flying at different speeds, the assessment of turbulence intensity by pilots, the frequency of turbulence encountered at different altitudes, and the time and space variability of turbulent zones. For example, the authors estimate on the basis of several studies that a characteristic time scale for duration of turbulence at some fixed point in the upper troposphere is about 5 hours. The rules of thumb and case descriptions make this probably the most interesting and least outdated chapter in the book.

The final chapter discusses larger-scale turbulence, in-

cluding the question of whether or not a specifal gap occurs in the free atmosphere (they conclude probably not) and a discussion of the turbulence energy budget in clearair turbulence zones.

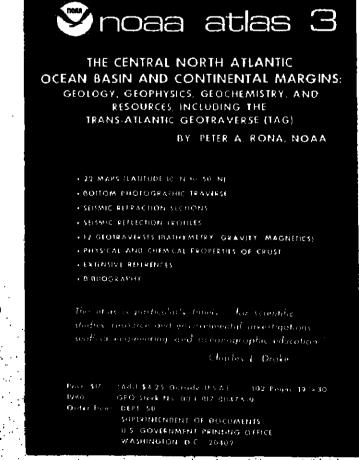
In several respects, this edition is inferior to the first edi-

tion. The excellent introductory chapter in the first edition by J. Dutton, which provided a complementary perspective on both theory and observations of turbulence, as well as an additional extensive list of references, is not included in this edition. Furthermore, the basic structure and concluslons of the book have not changed. In part this is because later observations have not significantly changed the picture. However, very little updating has actually been done. For example, of the 224 references, only 16 are after 1971. in addition, although the translation and technical aspects of the book are satisfactory, additional errors have crept Into the second edition. On page 217, for example, reference is made to work by Ackerman and by Malkus without including them in the references; in the first edition, they are included in the second edition, the references are listed in the text by author and number, and are not alphabetically listed in the back; in the first edition they are listed in

the text by author and date, and are alphabetically listed in the back.

In summary, the book is a useful reference for workers in the field to extensive observational work carried out in the Soviet Union before the early 1970's. However, it no longer represents the current state of the art in many areas of turbulence research. I would not recommend it as a basic text for gaining an understanding of almospheric turbulence. Furthermore, the second edition is not distinctly better than the first edition.

Donald H. Lenschow is with the Atmospheric Analysis and Prediction Division, NCAR, Boulder, Colorado. The National Center for Atmospheric Research is sponsored by the National Science Foundation.



ty of America, New York, 148 pp., \$17.00.

# The Scientific Ideas of G. K. Gilbert: An Assessment on the Occasion of the Centennial of the United States Geological Survey (1879–1979) Eills L. Yochelson (Ed.), Spec. Pap. 183, Geological Socie-

### Reviewed by William Benson

"If G. K. Gilbert Isn't the best geologist this country has ever produced, he surely is the one to beat for the title." Thus spoke one of my early mentors on the U.S. Geological Survey, and nothing I have since read, seen, or heard persuades me otherwise. Harold Urey, fresh from the discovery that Gilbert had anticipated by 50 years many of Urey's own ideas about the moon, marveled both at Gilbert's breadth and at his knack "for being right," for right he was on almost all of the varied phenomena toward which he turned his agite mind. Though not so stated (nor perhaps so-planned) this theme pervades Special Paper 183. As Hunt states (p. 25): "His accomplishments are especially impressive when viewed in the perspective of the status of geologic knowledge at the time. . .

Glibert's long and illustrious scientific career was completely intertwined with the beginnings and the early decades of the U.S. Geological Survey, and it seems litting that the Survey's centennial include a reprise of Grove Karl Gilbert. Such is the purpose of this volume.

The Glibert commemoration was originally planned as a symposium for the 1979 annual meeting of the Geological Society of America. But Gilbert's many contributions defied compression into any half-day session. Those who attended the symposium, therefore, will find in this volume as many new papers as those they heard in San Diego.

In addition to Yochelson's engaging preface, the volume

comprises 14 chapters, two on Gilbert, his career and his methods, and 12 on his varied contributions to science. Just the list of chapter titles (condensed and paraphrased below) is impressive:

1. A great engine of research, S. J. Pyne 2. Gilbert's contributions to glacial geology east of the Mississippi, G, W. White

3. Gilbert on laccoliths and intrusive structures, C. B. 4. Glibert's studies of faults, scarps, and earthquakes.

R. E. Wallace 5. Glibert's Lake Bonneville studies, C. B. Hunt

Pioneering work of Gilbert on gravity and isostasy.

D. R. Mabey 7. Glibert and the moon, Farouk El-Baz

8. Gilbert and ground water, A. F. Agnew 9. Gilbert-Bedding rhythms and geochronology, A. G.

10. Gilbert and the original barrier shorelines, J. C. Kraft 11. Glibert and iceberg-calving glaciers, Meir and Post

12. Techniques and interpretations: Gilbert's sediment studies, L. B. Leopold

Gilbert's geomorphology, Chorley and Beckinsale
 Analogies in Gilbert's philosophy of science, D. B.

Indeed the only subsets of geology that did not come under Glibert's analytical scrutiny were petrography, paleontology, and stratigraphy (though one might make a partial case for stratigraphy in view of his work on bedding rhythms). The scope is all the more remarkable when one realizes that nearly 20 years of his midlife were so taken up by administrative duties that his research was all but abandoned. As Powell's de facto deputy, Gilbert acquitted himself nobly as an administrator, but geologic research was the loser

Even long-time admirers of Glibert may discover new tid-

bits in this set of papers. How many, for instance, know that in the 1890's he tried (unsuccessfully) to persuade the Carnegie Institution of Washington to sponsor a "desp di hole for geophysical research"? Or that his Presidential Ac dress to the American Association of Geographers is the first U.S. paper to deal seriously with earthquake prediction? Or that this paper suggests all the major component of our modern programs? That he even proposed a version of the gap method for locating future quakes? These and many more await the reader.

Gilbert's exemplary literary style is not treated separated but shows through in the quotations from his papers. As any Gilbert fan knows, he wrote as clearly as he thought well realizing both the value of accurate communication and the fact that sloppy rhetoric may often conceal imperfect logic, in reply to a friend who had inquired how some recent graduates were faring on the Survey, Gilbert Wrote a "Their geology is all right; teach them to write bells English." The admonition obviously bears repetition local.

f Special Paper 183 has a defect it is the uneven styled the papers, an inevitable consequence of any collection of individual efforts. A few, notably those of Charlie Hunt and Bob Wallace, are sprightly enough to rank with Gilbert's own prose. Most of the others are clear and readable, but a couple are ponderous and laborious. No, I'm not going to tell you which, because even they are worth reading."

Historical or commemorative volumes are more often displayed on shelves and tables than are read. This one deserves a better fate. It has a lot of Interesting information, not only about G. K. Gilbert and his factual discoveries but about his wonderfully rational methodologies as well. Who knows? Reading this book may even inspire a trek to the F brary to sample the original Gilbert, a completely rewarding experience in itself.

William Benson is with the National Research Council, Washington, D.C.

# PLANETARY SCIENCE POSTDOCTORAL POSITIONS

University of Hawaii Institute for Astronomy

The Institute for Astronomy anticipates one or more positions to be available in the fall semester 1981 at the postdoctoral level. The positions are full-time, federally funded and annually renewable for a maximum of three years, subject to availability of funds The selected candidates will carry out theoretical and observational research on a NASA grant for ground-based planetary astronomy. Emphasis is placed on the outer planets and their satellites, comets, and asteroids

Minimum qualifications are a Ph.D. in astronomy or related field with experience in theory and data interpretation in planetary science, with a proven record as a researcher as demonstrated by publications and recommendations of peers. Salary will be commensurate with qualifications.

Submit a curriculum vitae with a list of publications and arrange for two letters of recmmendation to be sent to: Dr. John T. Jefferies, Director, Institute for Astronomy, 2680 Woodlawn Drive, Honolulu, HI 96822, Telephone (808) 948-8566.

Applications should be postmarked no later than August 15,1981.

The University of Hawaii is an equal opportunity/affirmative action employer.

Visiting Lecturer in Qeophysics. Geology Department seeks one year visiting lecturer 1981—82 to teach exploration geophysics and assist with operation of earthquake laboratory (includes WHSSN Station). Require Ph.D. or nearly completed Ph.D. Apply to the Geology Department, University of Montana, Missoula, MT 59812. Deadline Auport 1, 1981. Telephone (408) 243-2341.

Meetings

Joint Oceanographic Assembly

dan National Committee for SCOR.

The recently published second bulletin for the Joint

Oceanographic Assembly includes a general schedule of

sessions, registration information, and a registration form.

Scheduled for August 2-13, 1982, at Dalhousie University

in Halifax, Nova Scotla, the assembly is sponsored by the

Scientific Committee on Oceanic Research (SCOR), the

Commission for Marine Geology, the International Associa-

ton of Biological Oceanography, the International Associa-

neering Committee on Oceanic Resources, and the Cana-

To receive the bulletin and to be included on the list for

fulure mallings, contact Leo O'Quinn, Executive Secretary.

The second Symposium on the Composition of the Non-

urban Troposphere will be held the week of May 25, 1982.

in Williamsburg, Va. Objective of the meeting is to present

symposium is cosponsored by AGU, the American Mete-

the available information on the nonurban troposphere. The

orological Society, and the National Aeronautics and Space

Contributed papers are being solicited on the following

topics: background and nonurban measurements of tropo-

tropospheric gases and aerosols; interactions of tropo-

spheric gaseous and aerosol species; sources and sinks of

spheric gases and aerosols; transport of tropospheric spe-

des; stratosphere-troposphere exchange of trace species;

Deadline for reviewer's abstracts (200-400 words) and

shorter abstracts (100 words) for publication in the bulletin

Tishman, Program Coordinator, NASA Langley Re

search Center, Mail Stop 401B, Hampton, VA 23865. 88

of the AMS is October 15. Direct abstracts and questions to

models of nonurban troposphere; and interpretation and

significance of the composition of the nonurban tropo-

Joint Oceanographic Assembly 1982, 240 Sparks Street,

7th Floor West, Ottawa, Ontario K1A 0E6, Canada. 🛇

Nonurban Troposphere Symposium

ion of Meleorology and Atmospheric Physics, the Engi-

Research Selsmologist/Solid Earth Geophy-stes. ENSCO, Inc. in Springfield, Virginia is seek-ing a Program Manager/Research Selsmologist to support an expending program in solid earth geo-physics. Research areas will include: selsmic network data processing associated with the detection, identification and location of natural and man-made seismic sources; earthquake characterization and source mechanism studies; explosion source characterization; and empirical studies using near field and far field selemic data. Experience in theoretical and observational seismology at regional and tele-seismic distances, is highly desirable. Experience in digital time series analysis is desirable. Ph.D. in seismology is highly desirable, however, M.S. level with experience in earthquake and explosion seisnology will be considered. Salary and benefits are extremely competitive. Resumes along with selary requirements should be submitted to the Personnel Department at the address below, Attention Code SAS, ENSCO, Inc., 5408-A Port Royal Road, pringfield, VA 22151,

**Seismology.** Research associate position anticipated (September 1, 1981), telemetry monitoring project in Virginia. Problems focus on seismicity tonics in the state. Prefer M.S. geop icist with thesis in observational seismology, but others considered. Applications, transcripts and two letters of recommendation to: Dr. G. A. Bollinger, Seismological Observatory, VPI&SU, Blacksburg, Virginia 24061. Deadline for receipt of applications le August 1, 1981. VPI&SU is an equal opportunity/affirmative action

Mineralogy and Petrology. Applications are invited for a faculty position at Weeter State College, effective September 1981. This is a permanent faculty position with rank, salary, and tenure track status determined by qualifications. Responsibilities include teaching undergraduate courses in mineralogy, petrology, and geochemistry and some combination of mineral deposits, structural geology and introductory geology. Ph.D. preforred WSC is a large (10.000 students) undergraduate college with a strong geology program graduating about with a strong geology program graduating about 10-15 majors per year. The college is situated in northern Ulah at the boundary between Mountain and Great Basin Provinces and adjacon to the Overthrust Bett. The Department is well equipped for field-oriented teaching and research The closing date for applications is July 1, 1981 Applications, including evidence of teaching proli-ciency and the names of three references should

be sent to S. R. Ash, Chairman, Department of Geology/Geography, Weeber State College, 3750 Harrison Blvd., Ogden, Utah 84408. An equal opportunity:allumative action amployer, M:F.

STUDENT OPPORTUNITIES

Graduate Students Research Assistant-ships, St. Louis University, Paleomagnetic Laboratory. Two positions are open for paleomagnetic research work conducted under NSF sponsor. ship. The positions are for one year and are renewable. The candidates are expected to apply simultaneously for admission to graduate school pursue studies leading to a MS and/or Ph.D. de-gree in geophysics. For more information, contact: Dr. S. A. Vincenz, Department of Earth & Almos. Sciences, St. Louis University, P.O. Box 8099-Laclede Sta., St. Louis, MO 63156, Telephone (314) 658-3128 and simultaneously, Dean of Graduate School, St. Louis University, 221 N. Grand Bivd., St. Louis, MO 63103.

POSITIONS WANTED

Marine Geologist/Oceanographer. Ph.D. in geology, 12 years experience conducting physical oceanographic and sedimentologic studies in continental shelf, coastal, and fresh water environments. Thirty professional publications. Seeking challenging position in the New England area. Box 004, American Geophysical Union, 2000 Florida Avenue, N.W., Washington, O.C. 20009.

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POSITIONS AVAILABLE

Petrology Position Open. The Department of Geological Sciences at Columbia University invites applications for a research appointment in either igneous or metamorphic petrology, possibly with an orientation towards are deposits. The successful candidate would have research interests involving quantitation analysis of rocks. Research would be carried out at the Lamont-Doherty Geological Observatory Special funding arrangements and particpation in the instructional program are expected Rank and salary dependent upon qualifications. Candidates should submit curriculum vites and the mames of three referees to Professor W. S. racker, Lamont-Daherty Geological Observatory. Pal sades New York, 10964 by June 30, 1981 Columbia University is an equal opportunity om-

Research Salamologist. The Alexandria Laboratedes of Taledyne Centech Invites applications from Pn O -level selamologists to work on problems related to the comprehensive and breshold tost ban treaty negotiations. Applicants should have background to such topics as theoretical selamology, se said data analysis, se said data gothering. gy, seam, and unique, tolsent rate gamping, and annoting and annoting and computer systems. To apply please solid your resume to Jean Hill, Posonnel Department, Teledyne Gestech, 314 Manigomery Street, Alexandria, Vagina 22314. An equal opportunity employer.

Plasma Theorial. Depending on the availability of funds, the Center for Atmospheric and Space Sciences, Utah State University, could have a one year, postdoctoral position in theoretical plasma physics. Cardidales should have a Ph.D. degree and a background in nothness plasma physics and computer modelling. The appointes will primarily be computer modeling. The appointse will primarily be involved with the development of both 1-D and 2-D numerical models of double layers and electrostatic shocks. Please send a resume and the names of three references to R. Vf. Schunk, Physica Department, Utah State University, Logan, Utah, 84322. [Tel: (801) 750-2974]. Application deadline is June. 30, 1981 Position available August-September, 1981, Salary range commensurate with experience. Utah State University is an affirmative action/

edual opportunity employe

Research Position in Chemical Oceanography. California Institute of Technology, Division of Geological and Planetary Sciences. The position of research fellow is being offered at Calloch for research in oceanography Investigation of the isotopic composition of neodymium and rare earth abundances in sea water and sediments is now being carried forward. The mechanism of injection of REE into sea water will be studied. The differences in "Nd-1"Nd in various water masses (Prepgras et al., Earth and Planet. Sci. Lett. 45, 223-236 and Prepgras and Wasserburg, Earth and Planet. Sci. Lett. 50, 128-138 (1980)) is now being carned forward as an exploratory venture in order to determine the second of the second carnet. mine the origin and chemical behavior of REE in the ocean and the potential use of 14 No.14 No as a tracer. The laboratory facilities for sample preparation and analysis are fully functional and will be available. Applicants should have training in ocean graphy and a good perspective on general physi-

cal oceanographic models.

Send resume and references to Professor G. J.

Wasserburg, Lunatic Asylum, California Institute of Technology, Pasadena, CA 91125.

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Sedimentologist or Sedimentary Petrolo-gist/University of California, Santa Barbara. Applications are invited for a tenure track appointment in soft rock geology to be failed in 1981-82. Rank dependent on qualifications and experi-ence but preference will be given to the assistant professor level Applicant should normally have a Ph.D. and strong field-orientation and quantitative background. The candidate will be expected to de velop a strong research program in clastic sedi-mentation as related to basin analyses. The candidate will also be expected to teach at both under graduate and graduate levels and interact with students and faculty of the department, particula in the general areas of clastic diagenesis, volcar processes, paleomagnetics, as well as field geology. Additional duties may include teaching physical

geology and summer field geology.

Please send resume, other documentation of ablities, and four letters of recommendation by August 31, 1981 to Dr. Arthur G. Sylvester, Chairman, Department of Geological Sciences, University of California, Santa Barbara, CA 93106. Telephone

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sity. Candidates with an interest in any of the following are invited to apply for research staff ap-

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of seismic data analysis Princeton University has an ongoing program for the creative reanalysis of existing multichannel re flection data—such as COCORP and USGS offshore data. Special projects are undertaken from

time to time to collect field data in critical areas or

to test new methods of data collection and analysis A high performance 32 bit minicomputer system for data analysis and theoretical work is to be installed later this year. Applicants should send curriculum vites and a list of three references to:

Robert A. Phinney
Department of Geological and Geophysical Princeton University Princeton, NJ 08544

Or Inquire: 609-452-4118. Date of appointment and salary are negotiable.
Princeton University is an equal opportunity em-

# Consejo Nacional de Investigaciones Cientificas y Técnicas

# CHIEF OCEANOGRAPHER

A postdoctoral scientist with several years experience in physical oceanography is required at IADO (Instituto Argentino de Oceanografia), a joint institution of the Consejo Nacional de Investigaclones Científicas Y Técnicas (National Research Council), the Universidad del Sur, Bahía Blanca, and the Armada Argentina (Argentine Navy).

The applicant, in addition to research and postgraduate teaching in his own field, will also be responsible for the planning, coordination, and supervision of activities in other branches of oceanogra-

The position is under the auspices of a joint program of the Consejo Nacional de investigaciones Científicas y Técnicas (CONI-CET) and the interamerican Development Bank (IDB). It will be initially of medium duration, and is renewable.

It will be located at Bahía Blanca. Salary and fringe benefits according to qualification. Knowledge of Spanish language will be considered an advantage. For consultations or submitting applica-

Señor Presidente dei Consejo Nacional de Investigaciones Cientificas y Técnicas Avda, Rivadavia 1917 (1033) Buenos Aires, Argentina.

Applications should include complete academic and professional background along with a list of publications as well as names and addresses of three references.

# 2nd U.S.-Japan Seminar on 'High-Pressure Research: Applications in Geophysics'

The second U.S.-Japan seminar on High-Pressure Research: Applications in Geophysics was held in Hakone. Japan, January 12-15, 1981, under the auspices of the U.S.-Japan Cooperative Science Program between the Ja-

pan Society for the Promotion of Science (JSPS) and the U.S. National Science Foundation (NSF) The coconvenors were Syun-iti Akimoto (Japan) and Murli H. Manghnani (USA). The first such seminar was held in Honolulu, Ha-

# ASSEMBLY TRAVEL

Third Scientific Assembly, International Association of Meteorology and Atmospheric Physics, August 17-28, 1981, Hamburg, Germany

Fourth Scientific Assembly, International Association of Geomagnetism and Aeronomy, August 3-15, 1981, Edinburgh, Scotland

Universal Travel Service, Inc., of Washington, D.C., has been selected as official travel agent for these two assemblies. Contact Anna Monat. Universal Travel Service, Inc., 1825 Connecticut Avenue, N.W., Washington, D.C. 20009 (telephone: 202/667-3202) as soon as possible, indicating your requirements. Every effort will be made to obtain the best schedule and the lowest air fares available, such as super-APEX or group fare.

APEX (advance purchase excursion fare) must be booked 21 days in advance: minimum 7 days, maximum 180 days; \$50.00 penalty for any change after ticket is issued. A limited number of seats set aside on each air carrier for this low fare.

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Group fare: minimum 40 passengers traveling together, may return individually: tickets issued 21 days in advance. For those attending both assemblies, effort will be made to obtain suitable flights

From home city to New York (JFK) there are special add-on fares and, in some instances, super saver or published super-APEX fares that can be used in conjunction with transationtic flight. Northwest Airlines has direct service from New York to Glasgow (Prestwick). Pan American has daily service from New York to Hamburg: Northwest, twice weekly.

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August 1 JFK/Prestwick NW #38 depart 7:20 PM arrive August 2 8:00 AM August 16 Prestwick/JFK NW #39 depart 1:10 arrive same day 4:50 PM Super-APEX: \$549.00 Group: \$526.00

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August 15 JFK/Hamburg PAA #104 depart 9:45 PM arrive August 16 12:00 noon August 29 Hamburg/JFK PAA #101 depart 9:05 AM arrive same day 12:35 PM August 14 JFK/Homburg NW #30 deport 6:15 PM arrive August 15 9:30 AM August 29 Hamburg/JFK NW #31: depart 12:50 PM arrive same day 5:25 PM

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**Erosion And Sediment Trans**port in Pacific Rim Steeplands

Proceedings of the Christchurch Symposium January 1981

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wali, in 1976. Like the Hawaii seminar, the Hakone seminar was a tremendous success.

Twenty-two participants and observers from the U.S., 36 from Japan, and one each from Australia, the Republic of China (Taiwan), the USSR, Germany, and France attended the seminar. Some 47 papers were presented during the seven scientific sessions, covering a wide spectrum of recent advancements in the field. The areas emphasized were: the state of the art of high-pressure science and technology, crystal chemistry and phase transitions, shock wave results, and application of the various high-pressure experimental data to elucidation of the geophysical and geochemical nature of the earth's Interior, in keeping with the seismic data and petrological models. The seminar provided the participants and observers a unique opportunity for discussing new data and ideas. The seminar also opened further avenues for the Japanese and U.S. scientials to cooperate in scientific endeavors.

The proceedings of the seminar will be published in a book 'High-Pressure Research in Geophysics' (S. Akimoto

# Ocean Sciences: AGU/ASLO Joint Meeting S AGUASLO C

Joint Meeting

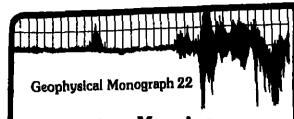
February 16 1) 1982 San Antonio Fevas

Fobruary 16-19, 1982 San Antonio, Texas Convenor: W. D. Nowlin, Jr., (AGU) and R. W. Epply (ASLO)

Call for papers to be published in Eos, late June. See Eos. April 21 for first

and M. H. Manghnani, editors) by the Center for Academic Publications, Japan, at the end of 1981.

This meeting report was edited by Peter Bell from information supplied by the convenors.



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# Aeronomy

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CONGRESSION REPORTED THE AND THE MAINTAINE FOR CONTRACT FOR THE CONTRACT F J. D. Belly and W. B. Wichest 1581 International Fedio Physics I absentory, Ponto Park, CA 9-023). The Chatanija Radar has been used to cassure the table of storic (c<sup>2</sup>) lone to calcular (c<sup>2</sup>, c<sup>3</sup>) lone in file flucient (c) the storic transfer. The radar results agreed bell with similar results agreed bell with similar results agreed bell with similar consideration. raise results agained well with visual tameous invita incher data, gloin, confidence in the redarrise 1 of declaring teal comparation. Passagement
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to state, there is supported in the resolution attentude, where the number densities of storic and
microular lone are equal, is a concentent paramater for describing the composition variation
with altitude or "or position shirted profile."
For transition skittedo occurs at a 100 km at
right and a 170 km daylog the day, in agreecent
with didictitude craults, buring the winter the
daylow transition sixtude is 15 km loose then
in surfar, a seasonal variation sixtude to that
at riddictitudes. Energotic particle profilitation sequits in the lowering of the transition
sixticles deposited - TO expect2-s in the straspicce. The largest variations in ton compoeletions, by 10 km in one case when emergatic particles deposited - 70 ergafects in the arrosphere. The largest varieties in ten cooperables. The largest varieties in ten cooperables made from a feet during precise of large joule best input resulting from electric fields on the order of 50 mVm. The transition stitude from said by 50 km in a was where the joule best input sate was 10 args/cc-a. These observations were corporated to calculations from a sipple stead, water cole involving the principal constituents and reaction. The results indicate that the transition mattitude during particle precipitation. There do not appear to be significant effects from possible increases of My without cold in the first superstance. A marber of interscalated affects constitute to the increase in transition attitude during joule beating. The cast important affect is the electric-field contribution in ration; the effective ion temperature, in addition, it appears that increased My density is all the required to account for the Cast made of Castaling, function precipitation). It Geograps, Shape Paper 180692

MAN COMPOSITEION EXTENSED STATUTE ACID VAPOR CONCENTRATION MEAS-TRANSING IN THE ATRACOSPRENE EXTINCTED SLITICALC ACID VAPOR CONCENTRATION MEAS-TABELIST IN THE STRANDSPRERE
A.A. Viggland and P. Arraid (Mar-Planck-Institut for isomphysis, 2000 juiceliberg, P.R. Germany)
The factor nearwealths of attracespacing 500 vapor concentrations using passive chemotomisation mass spectrometry are continued. This work sa-teris the attitude range of the measurements from 19.6 10 15.0 km. The results indicate a low con-ceptation below eggs-minarely 30 km, followed by m shifp time to a captum value of imply noise-cular rate at the content of the pro-vious rate at the content of the pro-vious rate at the content of the pro-sults at compared with provious consumments and the recent at the content and of the protheoretical acidels. (Sulfurir acid vapor, aerosols, restiva icon).
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GAAG Consection, diffusion, mixing, turbulance, and fallout properties of properties of the properties sgreening, J., Sasphys., Res., Stoom, Paper 100105

# Electromagnetics

0730 Electromagnetic Theory MULTIWODE PROPAGATION IN ANISOTROPIC OPTICAL WAVE-GUIDES

D. K. Paul (Gordon McKay Laboratory, Harvard University, Cambridge, Massachusetts) and R. K. Shav

ovarity, Cambridge, Massachusettel and R. K. Shargonkar
Using far from cut-off approximation (2e/A<sub>0</sub>» 1)
we have derived elegant expressions for the characteristic equations and their relevant solutions to
determine the guided wave features of an optical
waveguide having an axial delectric anisotropy.
Jieo, the attenuation constant has been calculated
following the concept of a complex permittivity in
a lossy tedium. For TE, TM as well as bybrid modes
studied here, the results computed by the approxicate method show very good agreement with those of
the such analytical solutions. The dependence of
the power carrying capacity and attenuation on the
waveguide parameters highlights the usefulness of
the dielectric anisotropy in optical waveguides.
Red. Sci., Paper 150141

0733 Remote sensing ESTIMATION OF SUFFACE TENPERATURE VARIATIONS DUE TO CHANGES IN SET AND SOLAR FULW WITH RLEVATION S. Haums-Killer (U.S. Gaological Surrey, Box 27046 Federal Center, Stop 784, Denver, Colorado Anosas

Student Pederal Center, Stop 964, Denver, Colorado 30225)
Sky and solar radiance are of major importance in determining the ground temperature. Enouglade of their behavior by a fundamental part of surface temperature models. These two fluxes vary with elevation and this variantions produces comperature changes. Therefore, when using thereal-property differences to discriminate geologic materials, these flux variations with elevation meed to be considered. From a representative set of field observations, it was found that flux variations with elevation can cause changes in the mean diornal temperature aradiant from -4° to -14° per km evaluated at 2000 n. Changes in the camperature-difference gradient of 10-2° per km evaluated at 10-2° per here also produced which is equivalent to an effective thermaliments gradient of 100 W 11' m<sup>-2</sup> K<sup>-1</sup> per km. Thus, exposed bedrock on topographic ridges will appear to have a lower thermal intercia due to the addictional effect. (Solar and sky fluxes, elevation affects, reacte squaing). Georphys. Res. Lett., Paper ILOS02

OTEO HERROR EAFERDENT ON EM BACEBCATTER FROM FAMILY-BUTEVAN AND GRADIENT DRIFT MAYES 1. J. Alport (Pept of Fingles and Anti-Ondry, University of Iowa, Iowa City, Iowa 52242) 1. J. Angelo and H. I. Picaeli

Hemulto are reported of a laboratory experiment on Bragg backscatter of 3 cm microwaves by The propent work is the third in a series of J. Goophys. Ros., Blug, Paper 1A0823

O773 Remote sensing
REMOTE SENSING OF MUON VARIATION
SENSTRA AND INTERPLANETARY INMONOGENEITIES.
M.El-Rasy(Department of Physics, Facof Science, University of Alexandria,
Alexandria, Egypt.) and S.Caber
The similarity between the general
remote sensing integral equation and
Dorman's equation relating secondary
to primary muon variation spectra, borman's equation rolating secondary to primary muon variation spectra, has been pointed out and oxploited. Primary muon variation spectra and parameters of interplanetary field inhomogeneities are remotely seased by a nonlinear inversion technique, using two different coupling functions. Results are compared to those obtained by the spectrographic technique and interpreted in terms of interplanetary field fluctuations. Based on relationships among kernels of the integral equation, optimisation of location and orientation of measuring stations, becomes possible. (Remote sensing, muons, interplanetary inhomogeneities).

J. Geophys. Res., Elue, Paper 140809

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# izvestiya Physics of the Solid Earth

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Eljurtin granitic mass

CHRONICLE

Sobolev G. A. International Symposium on Earthquake Frediction, UNESCO, Paris, 125 2 6 April 1979
New geophysical journal aGeofisichesky zhurnals

# iti Chmistry of the atmosphere IN PRINCERMISTRY OF CARSON MONOSULFIDE: A NISHER SQUARE FOR ATMOSPHERIC GOS Sim had her (Atmospheric and Rovironmentel bracch, In., Casbridge, Messachusetts U2139) If Saicola E. W. Ko Carbo monosulfide (CS) may be formed in the tiscaphere by oxidation of CB2. We propose that Listquare reaction of CS wich known atmospheric recise sight lead to the production of CCS in silition to that of SQ. We discuss various Finishitties whereby the atmospheric CGS content lith metalisted by oxidation of CS. (CS, CCS, Latys, Res.) ton Canistry of the absorphere 7. C. 1906 OF 01:31 SY O2(a A.) 7. C. 1908 and G. Black (Milecular Physical 6:23)

**Exploration Geophysics** 

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CENCIL CRUST OF A MODIFIED MAGNETOMETRIC
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(\* M. Electric Character) of Physics. University
(\* Memoio, Toronto, Ontario) L.K. Law and

ESSIVITI (Department of Physics, Driversity 28, Eleards (Department of Physics, Driversity 7), conto, foronto, charle) L.K. Lew and 7 conto, foronto, charle) L.K. Lew and 7 conto, foronto, charle) L.K. Lew and 12 conto 12 conto

UNION SALAWAT STACKS USING FINITE-LENGTH HOURD SECTIONS

1. K. Srocher (Hawaii Institute of Geophysics, threateny of Hawaii, 2525 Corres Road, Hopolulu, Brail 19622) and R. A. Phinnsy (Department of Geological and Geophysical Sciences, Princaton Environ of Sinta Stacks for velocity-depth incites using only the incarcapt time, r(p), is adoptised. We propose inverting slant such using their integrated power, P(p), as an additional constraint. Dismontinuities in wholity-depth functions, v(s), and changes in wholity gradients cause losses of P(p) only for niced sections of finite-length. In practice its, the observed P(p) may be used to constraintial took t(p) and play are found directly from its slent stacks. Another advancage is that took T(p) and P(p) are found directly from its slent stacks. Another advancage is chantelity structures are very rapidly and accurately infarred. Finally, the method is not chick to bisses as are mathods which suplay little-artivals unly. (\*r-p, slant stacks, in-rision, COCORP).

1. Corphys. Res., Red, Papar 180343

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ind, the latter represented by bicubic spline fraction, Taxtion, To test the method in practice, we have applied it to (1) synthetic data generated from an constructivist, and (2) real data obtained from marine winds sections. In the latter case, velocities of inflactor depths obtained were compared to the obtained directly from a well log in the test. Here results show a reasonably good resolution for layout that are not too deep relative to the staffractive offsets used. For deep and/or the layout that are not settlefactory. Dut indicates the general limitation of melantic filecting data to resolve interval velocity, even in the presence of horizontally layered structure. Explysics, Vol. 46, No. 7

**Geochemistry** 

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the Catalery), Sophys. Res. Lett., Paper 11,0725

ind Obelstry of the solid earth
REDALOICAL AND CHEMICAL EFFECTS OF HYDRATION
L. Senford (U.S. Seplential Servey: N.S. 916;
Wheation reactions of 18226)
Wheation reactions occurring during retrograde

metamorphism of ignaous or high-grade metamorphic rocks can be expected to show mystematic effects due to the lowering of water pressure (PNG) below that of pure water at the same tangarature and testal (rock) pressure (PN). These effects are: 1) Equilibrium phase relations are limited to small domains; larger domains may be characterized by more phases than are possible according to the phase rule. 2) More phases are possible in an equilibrium stamblage during retrograde netamorphism (where, generally, PNG (P) than during prograde metamorphism of kph-bearing rock iwhere PNGO a P, 1). 3) The fluid and minnerals tend to be enriched in species that preferentially partition into the fluid. 4) Halides and other very soluble phases may precipitate along grain boundaries. 5) Enrichment of a rock in components that preferentially partition into the fluid is selective according to the amount of water available for hydration; partially altered rock will show the greatest enrichment. All these features are observed in serpentinized ultramafic rocks. For example, during prograde metamorphism the sequence, thrysotile antigorite stability field may be bypassed commonly between the ratrograde sequence is typically forsterite a chrysotile (2 brucite or taic). The antigorite stability field may be bypassed commonly because of low PMGO. Also serpentinized in fictor of the palecomposition of hydrothermal and metamorphic fluids. (Hydration, PNGO Pp., retrograde metamorphism, fluid-rock interaction, serpentinization).

4260 Paragemasis, petrography, and petrogenesis

4260 Paragensis, petrography, and petrogensis MINERACOTICAL AND CHEMICAL EFFECTS OF HYDRATION REACTIONS AND APPLICATIONS TO SERPENTINIZATION See 1440 Chemistry of the solid earth Am. Mineralogist, 66, 3-4

1440 Chemistry of the solid earth
ELECTRON MICROPROBE SIGNES OF ICELAND RESEARCH
DRILLING PROJECT HIGH TEMPERATURE MYDROTHERMAL
MINERAL GEOCHEMISTRY
R. A. Exley (Department of Geophysical Sciences,
University of Chicago, Chicago, Illinois 60537)
The geochemistry of epidote- and chlorizedominated hydrothermal assemblages in the
Iceland Research Drilling Project (IRDP) drill
core has been studied by electron microprobe. The
association of epidote, andraolize and Cu-Fe
sulphides suggeste maximum baselt alleration
temperatures of 350°-300°C. Near pure andradite
implies a fluid XCO<sub>2</sub> <0.05. The sequence of
successively lower temperature minorals (epidote,
prehnite, laurontite) in velns and vesicles
suggests precipitation during rapid cooling from
>300°C to <200°C, and Logether with zonation in rewith time. The eradication of probable early
zeolite facies assemblages and this cooling
sequence suggest that temperatures vose to >300°C
during burial of the lower part of the IRDP sequence before vigorous fluid circulation, producing rapid cooling and intense alteration, was
established. Transition metals (Fe, Nn, Cu) were
released from primary assemblages, but were incorporated in chlorite, spidote and sulphide.
Epidote contains average Sro! o .0.23T, but intersemple variations in trace element contents of
secondary minerals are complex, and there are no
correlations with depth. It is concluded that the
effects on whole rock chemistry (Including Sr) and
secondary mineral chemistry were largely controlled
by kinetic factors such as (il differing responses
to alteration by primary assemblages and (il)
permeability variations.
J. Geophya. Rea., Red, Paper 180751

1440 Chemistry of the solid earth THREE S-TYPE FOLCABIC SUITES FROM THE LACHLAN THERE S-TYPE FOLCANIC SUITES FROM THE LACELAN POLD SHLT, SE AUSTRALIA B. Hyborn (Sureau of Hiseral Penources, P.O. Box 378 Cemberra City ACT 2601, Australia B.W. Chappelised R.M. Johnston The comcept that granisoids of the Lachian Fold Belt in south-seat Australia, Are derived from

helt in south-ment Australia, are new vow and the sither igneous or sedimentary souther cocks il- of 5-typs), can be extended to volcasic cocks of the same sgs. Three suites of late fillurian 5-type volcanics are described, two of which can be volcanic and the allocation with niversity suitests. Setyps), can be extended to volcanic rocks of the same age. Three suites of late filturin 5-type volcanics are described, two of which can be matched quite closely with plutonic equivalents. A large part of the Paleonoic continental sargin volcanic sethicty in south-east Australia ronsisted of the magnatic recycling of old matesisted on the corresponding presence of Ai-rich minerale. Variation within the volcanic suites is serviced chiefly to progressive resowal of restite, or source material residual from partial mating. The most saffic suite, the Hawkins Suite, contains plagicalses cordistrite, orthopyrouses, biotics and quarks as restite components, with less shundant almonication, these rocks are chemically equivalent to mafic biotic—rich and cordistric—barring granitoids from parts of the Berridels and Hurrumbidges Eatholiths. Garnat is absent from the Goobarragendra Bulke volcanics, which was little more falsic and close to composition to granifoids of the Young and Haragle Batholiths. The E-type character of the Laidlaw Suite is less pronounced although a sodiamnary source same to be actabilished. Such a source would be less maurer than those for the other two volcanic mutes. The Laidlaw Suite resumbles, but cannot be closely identified with, falsic S-type gramitoids of the Murumbidges and Bertlable Butholiths.

Low-grade regional metsonophism in nost of the volcapic codes has resulted in much mineralogical alteration and mubility of alkalf and alkaline earth elements. Despite this startation, waster source before articles and Goobarragendra Suiter resultilipated at lower pressures than their source before attraand Goobarragendra Suiter resultilipated at lower pressures than their source before attra-

there. Differing mineral compositions in the three suites are related to differing source rock composition and onymen fugacities. Relative biotite and orthopycoxume mg is possibly pressure dependent. (volunic rocks

# **Geodesy and Gravity**

iggo High-order harmonics of the gravity potantial field and local gravity anome less MODIFYING STOKES' FUNCTION TO REDUCE THE ERROR OF GEOID UNDULATION COMPUTATIONS:

C. Jakali (Department of Geodet to Science, The Ohio State University, 1958 Reil Avenue, Columbus, Ohio 43210)

A comparison is made of the errors in detarmining the sand undulation according to the conventional Molodenskii truncation Indeprised its modifications, as suggested by Molodenskii and by Periss!. The undulation is assumed to be computed from gravity anomalies in a spherical cap and a finite, set of harmonic potantial cal cap and a finite, set of harmonic potantial as the neglect of high-degree coefficients are considered. It is found that the aprovestic considered in the consideration when the conventional method. For example, arrorless and continuous gravity data in a tag with 10' radius and the GPND coefficients are reported in the conventional method. For example, arrorless and continuous gravity data in a tag with 10' radius and the GPND coefficients are reported and a subject to the conventional field truncation theory is applied, and Al can and 33 cm with an average error of 109 cm if the unaddifficed truncation theory is applied, and and, a Molodenskii type of modification.

I. Geophya, Ban, Real, Paper 1,80708

# Geomagnetism and **Paleomagnetism**

2510 Dyamo theories
SATURY'S PACKETIC FIELD AND HYMAY, THROWY
J. Todosachuck (Applied Goodlysica Laboratory,
Department of Mining & Satallaripel inginouring,
KG111 University, 1480 University Street,
Kontreal, Purboc, Casada Ula ZA77 D. Crossive
and H. Sochester
Chaorwations have shown that Satura's reportic
field is recarshably exisymmetric and ottompty
dipolar. On reviewing three possible explanations
for the field generation process we view a
Braginshil nearly axisymmetric dynamo radel as
compatible with both the power requirements and
that tilt angle in a large Saturalan core. If the
core is sufficiently scall them a ram field
dynamo becomes a rore libely continue, whereas
if both these codels full an axisymmetric dynamo
becomes a rore libely continue, whereas
if both these codels full an axisymmetric dynamo
based on corposabile flow may be possible.
(Dynamo theory, Satura, planutary interiors,
wagnetic fields).
Geophys, Fee, Lett, Paper [10190]

2510 Dynamo theories ROTATION OF THE BINER CORE D. Gubbins (Bullard Labs. Dept of Farth Sciences, Madingley Rise, Madingley Road, Cambridge CB3 OEZ, England) We cannot observe the magnetic field inside We cannot observe the magnetic field inside the Earth's core directly but there is likely to be a large toroids! part of 10 - 100 Gauss which, together with the dipole component, could produce a magnetic lorque on the inner core that lends to rotate it. Estimates based on dynamo calculations give torques of 10 N.m. which is large enough to accelerate the inner core to the westward drift velocity of . 20 per year within a few days. Presumably source core to the westward drift velocity of .2" per year within a few days. Presumably some equilibrium has been reached in which the inner core rotates with constant angular velocity and experiences no net torque. This rotation should have significant consequences for dynamic calculations because it is a very effective method of stretching field lines, and it helps to drive differential rotation in the liquid outer. drive differential rotation in the liquid outer core. The core is modelled by two soils! apheres permeated by a uniform field of 5 Gauss representing the dipole. The loner sphere is free to rotate relative to the outer sphere. When a torque of 10 N.m., is applied to the inner sphere it reaches equilibrium with a sleady angular velocity corresponding to a rotation period of 2300 years, which is similar to the westward drift speed, and a toroidel field of about 100 Gauss is induced. The inner aphere can also undergo lorsional oscillations with a period of about tan years which may be related to the observed secular variations, J. Geophys. Res., Ref. Paper 180413

25th System variations, attributed to sea floor spreading to the property of t

of california, Poiss, (A. 2007), and Fidition Moores.
Falconaged in simples of name Fidit baselfs have shallowed anothing one which would be interest from the presidentiated at which the baselfs note controlled at majorical relativistics of the geomagnetic field, the anothing expendite farmatic results for the geomagnetic field, the anothing expendite farmatic field, the anothing expension of the field, the anothing expension of the field, the anothing expension of the field to the field to the field of the extensional regions region occurring to confi-nental course observations of the Treeles

estensional totant, regard covering in continuous reverse the special continuous of the Treedow continuous special continuous of the Treedow continuous special continuous continuous special continuous continuous regards. The terrents restate as the majoration religion, the terrents restate as the military free deserted along the instructions required faults cover about a horizontal axis generally perpendicular to the extension direction and appropriate about to the extension direction and appropriate and large as 70 to 50 are not uncommon. The paleocaments is encourageness of these retainings and be calculated for PuPP bistats if the original struke and latitude of a ridge are known, at four PSP sites for which abequate data its available, namely Sites 110. 312, 410 and 417, retarious reaging from the total continuous as is the case for most of the cider parts of the Pacific Ocean, the paleocament data and the inferred rotation determine a relationship between possible ridge strikes and iccortions. This information, continued with a similar but subjectment relationship derived from the railine cagnetic annualities, puts severe constraints on the original arribe and location of the ridge. of the ridge. J. Geophys. Ros., Red, Paper 180575

2550 Time variations, diurnal to secular MAGNETIC SIGNALS FROM THE CORE OF THE EARTH AND SECULAR VARIATIONS. Denver federal Center, NS 954, Denver, Coloredo 80225, USA)

An osciliating, radial asquatic dipole source was assumed to majst in the core of the Earth, 100 to bineath the core-maintle boundary. As an approximation, electromagnetic propagation was assumed in the core in lieu of hydrosagaetic propagation, which could not be used because of unknown internal fields. Using Dehye potantials, the radial and horizontal components of the surface fields were calculated using various assumed conductivity parameters in the core and in the manile. It is concluded that not spherical hermonic models of the Earth's magnetic field de moliaclude enough terms to properly describe the field of core sources with periods of tens of years. These short-period variations are

especially important in describing the socular variation. Because of this, a oraper description of the socular variation requires care spherical harmonic sens than are required for the field itself. Inadequate representation of short-period variations in spherical harmonic models ray contributed to the replid deterioration of predictive models. Alternatives to spherical harmonic analysis for secular variation should be investigated; but, regardless of the rethod used a ruch greater spatial distribution of high quality serular variation data is negled. It deeplys Res., Fed., Paper 180945

# Hydrology

Hydrology

3110 Environ and sedimentation
necongenery the Confidence of BED-AFFRICA
015(MARGE IN A SPALLOW SANDED STORM.

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1110 Aroundwater A SPOCHASTIC APPROACH FOR DESCRIBING CONVECTIVE-DISPERSIVE SOLUTE TRANSPORT IN SATURATED PORCES R.V. Ban and K.W. Furtisms (Statistics Decasions)

HEDIA
P.S. Rao and S.K. Fortier (Statistics Deposition),
University of Floridal and C.S.C. Rao (Soil)
Science Department, University of Florida,
Calmandilla, Florida, U.C.A.)
A stochastic approach to used to ridel
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A PARMOUNTICAL MODEL FOR COMMODITION IN A THEMSOPLASTIC ACCURES SUBSIDENCE FOR THEMSOP PART 2: PRESENTED ACCURES SUBSIDENCE FOR THEMSOP FOR VEFIL-AL AND HOPEZOWARD DISPLACIMENTS

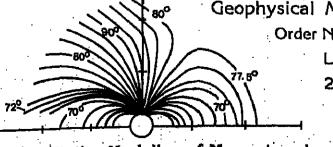
J. B.-17 (Technion-Israel Institute of Technology, Haifa, Israel JROOD) and M. Y. Corepcioglu (Capartment of Civil Engineering, Cniv. of Delaware, Neward, DE 19711)

A rathemstical model for regional subsidence due to pumping from an aguifer is devoloped on the basis of Biot's work on coupled three-disantional consolidation.

Following Biot's work on three-dimensional consolidation, with coupling between mass conservation and equilibrium equations, a mathematical model for regional subsidence due to pumping from an aguifer to developed by awaraging the three-dimensional model over the thickness of the aguifer and assuming conditions of place stream. Soch (westical) land subsidence and forizontal displacements, as functions of place stream. Soch (westical) land subsidence and forizontal displacements, as functions of place stream. Soch (westical) subsidence on analytical solution is presented for the appellal came of a stagle well pumping from an infinite honogeneous Sockmopte aguifer. The solution provides estimates of changes in averaged (over the westical) whice of piezoneric head, vertical subsidence and horizontal displacement. The results indicate that under the conditions of the studied came of radial flow, the solutions for piezoneric head is identical to the one obtained by mon-coupled models. Furthermore, half the volume strain is produced by vertical subsidence, while the moter half by the horizontal displacement.

Howe, the vertical subsidence is only approminately half the value obtained is non-coupled models which register beauties the some considered in some coupled models.

Water Tombur. Hem., Paper 1900A6

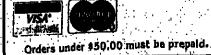


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# Quantitative Modeling of Magnetospheric Processes edited by W.P. Olson (1979)

Providing an annotated list of quantitative models which serve as a reference on energy particle distribution and magnetic and electric models, this monograph was written in conjunction with the international Magnetospheric Study's activities.



Published by: American Geophysical Union 2000 Florida Avenue, N.W. Washington, D.C. 20009